The Timber Resource In MASSACHUSETTS

Northeastern Forest Experiment Station, 1945-

Upper Darby, Pennsylvania
Ralph W. Marquis, Director

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ACKNOWLEDGMENTS

In making its forest survey of Massachusetts, the U. S. Forest Service enjoyed the cooperation of the Massachusetts Department of Natural Resources, Division of Forests and Parks. The Division of Forests and Parks supplied the aerial photographs that were used in making the survey and gave other valuable assistance. The Harvard Forest at Petersham, Massachusetts, cooperated by providing office space for field personnel. The Forest Service gratefully acknowledges the help these agencies gave.

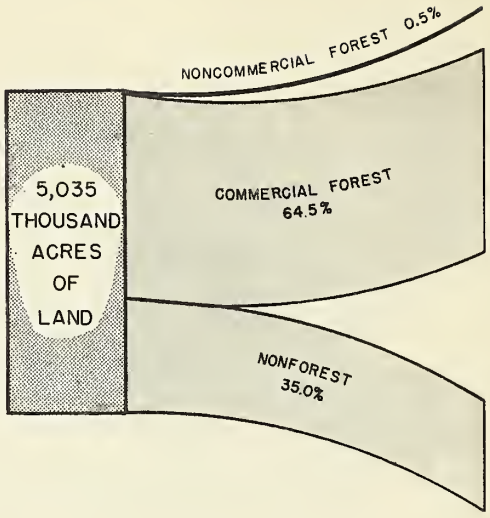
PREFACE

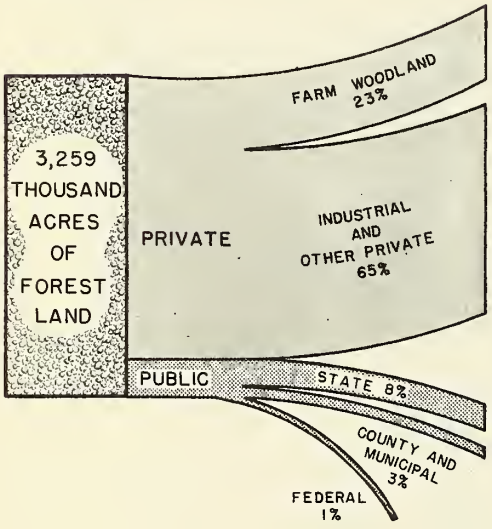
This is a report on the findings of the forest survey made in Massachusetts as part of a nationwide forest survey that is being carried on by the Forest Service, U. S. Department of Agriculture. This report shows, for the year 1953, the area and condition of the forest land, the volume and quality of standing timber, the rates of timber growth and mortality, and the extent of timber cutting for forest products. Field work for this survey was begun in February 1953 and was completed in March 1954.

The first forest survey of Massachusetts was made between 1915 and 1928 under the direction of William A. L. Bazely, State Forester. It was concerned primarily with forest area by types and size classes. No estimates of volume were made. Since then, other estimates of forest area as well as timber volume have been made. Because of changing definitions, standards, and procedures, few changes in forest conditions can be gaged by comparing the data in this report with earlier estimates.

THE HIGHLIGHTS

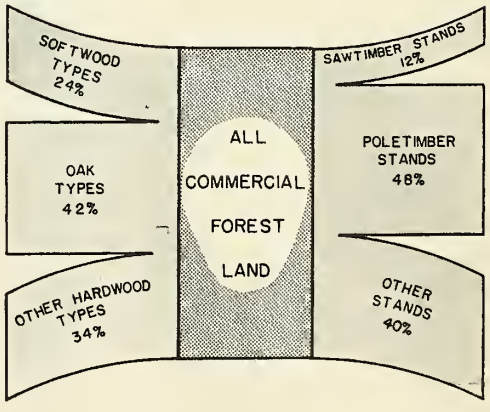
FORESTS occupy nearly two thirds of the land area in Massachusetts. Except for 29,000 acres, all the forest area is commercial forest land.

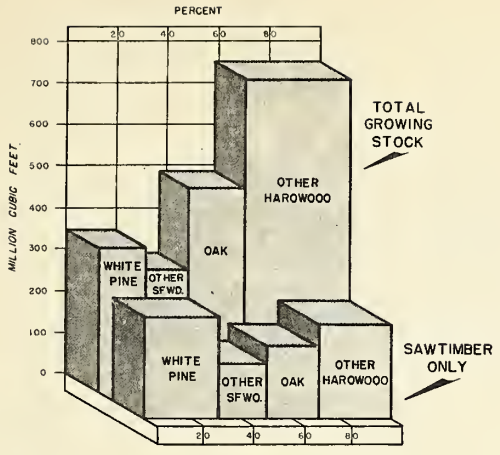




PRIVATE owners hold 88% of the commercial forest land. These ownerships include 9,000 farms and 21,000 other holdings. Most of the public forest land is State-owned.

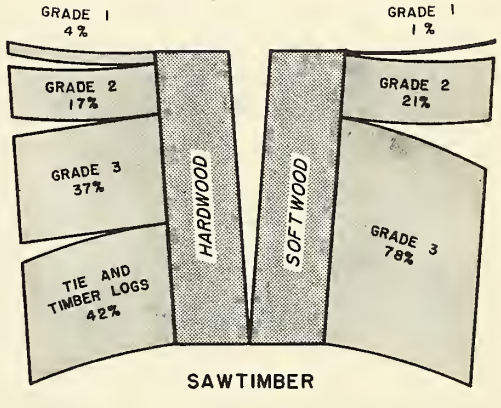
THE HARDWOOD forest types cover over three fourths of the commercial forest land. Sawtimber stands of 1,500 or more board feet per acre occur on 12% of the forest area.

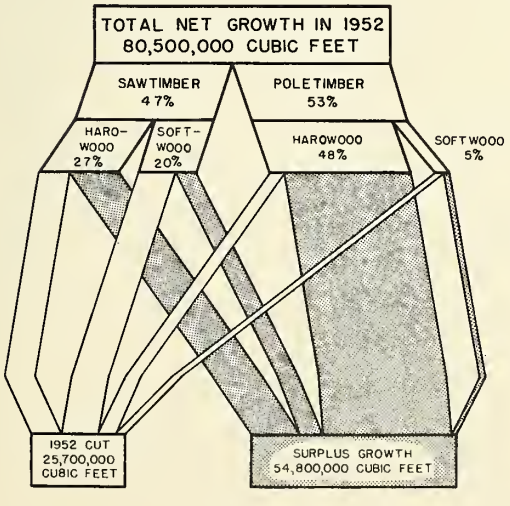




THE FOREST growing stock amounts to 1,900,000,000 cubic feet of sound wood. Included in this volume are 2,700,000,000 board feet of sawtimber, about equally divided between softwoods and hardwoods.

A GREAT part of the sawtimber is in low-quality logs. Only about 4% of the hardwood volume and 1% of the softwood volume are suitable for Grade 1 standard lumber logs.





THE NET GROWTH of forest growing stock in 1952 was about 80,000,000 cubic feet. The 1952 cut from growing stock was almost 26,000,000 cubic feet. The great surplus growth was in the hardwoods.

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A report on

THE TIMBER RESOURCE IN MASSACHUSETTS

by

Roland H. Ferguson *and* Milford C. Howard

Northeastern Forest Experiment Station

Forest Service, U.S. Dept. Agriculture

INTRODUCTION

EVEN THOUGH MASSACHUSETTS is a densely populated state, two-thirds of its land area are covered by forest growth. The forest survey recently completed in Massachusetts shows that the state has 3.3 million acres of commercial forest land. This land supports 2.7 billion board feet of timber, an average of 800 board feet per acre.

This volume is much less than the forest lands of Massachusetts could support. And in this the findings of the forest survey reveal an opportunity: the growing of a larger volume of high-quality timber, which could contribute to the over-all economy of the state, would be a feasible aim for the forest-land owners of Massachusetts.

The population of Massachusetts is mostly urban; there are almost 600 persons per square mile. (Only one other state--Rhode Island--is more densely populated.) Most of the $4\frac{1}{2}$ million people who live in Massachusetts work in the manufacturing industries, retail and wholesale businesses, and service trades.[1] Manufacturing industries account for more than a third of the total employment.

[1]United States Bureau of the Census. U. S. Census of Population 1950, Massachusetts vol. 2 part 21. 308 pp. 1952. (See tables 30 and 79.)

Agriculture provides employment for only 1½ percent of the labor force. Forestry and the primary forest-products industries (lumber, pulp and paper, and furniture) account for slightly more than 3 percent.

FORESTS FOR WATER AND RECREATION

Though this report is mainly about timber, there are other forest values that are also important to the industries and people of Massachusetts. One is the water resource. Another is the use of forests for recreation.

Watershed protection is probably the greatest contribution that forests make to the welfare of the state. Forested watersheds minimize flood hazards, stabilize stream flow, and help to assure reliable supplies of good clear water, which industries and city populations demand in great quantities.

Outdoor recreation facilities are important in any area as heavily populated as Massachusetts. Millions of people use the forests for hunting, fishing, camping, and hiking. In the year ended June 30, 1954, sportsmen paid out $1,028,321 for hunting and fishing permits. More than 3 million persons visited the 16 state parks and reservations, and an untold number made use of 28 state forests that are developed for recreational use. It is estimated that tourists spend about $3 million in Massachusetts every year.[2]

INCOME DUE TO TIMBER USE

Although no exact figures are available, it is estimated that value added by manufacture in the three industries that use timber products as their major raw material (paper, furniture, and lumber) exceeds $300 million annually.[3] In addition, the use of wood in construction, transportation, wholesale and retail trade, and many other wood-using activities probably gives rise to income equally as large.

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[2]New England Council. The vacation business of New England. 27 pp. 1954.

[3]U. S. Bureau of the Census. Annual survey of manufactures 1952. 218 pp. 1953. This survey reports value added by manufacture: $220,000,000 in the paper and allied products industries, and $69,000,000 in the furniture and fixtures industry. The survey does not give an estimate of value added by manufacture of lumber and lumber products. However, it seems likely that 30 to 35 million dollars would be a reasonable estimate for these industries.

Massachusetts forest owners and loggers receive more than $1\frac{1}{2}$ million annually from sale of the sawlogs, pulpwood, and other timber products they harvest. Their return is relatively small because they supply only a minor fraction of the timber products used in the state. Whereas wood consumption averages about 78 cubic feet per person nationally, timber-products output in Massachusetts is less than 6 cubic feet per person. If Massachusetts consumption is near average, the state consumes about thirteen times as much wood as it produces. Most of the income due to timber use in Massachusetts (probably more than 90 percent) is due to the use of pulp, lumber, and other raw materials made from timber grown in other states and in foreign countries.

The role that timber plays in the Massachusetts economy is also reflected in employment and wages. The state's lumber, paper, and furniture industries employ more than 50,000 persons; and their payrolls are close to $200,000,000 annually.[4]

USE OF THE TIMBER RESOURCE

When the first colonists landed in what is now Massachusetts, they found a vast area of unbroken forest. There were fine virgin stands of white pine in mixture with hemlock and hardwoods. The colonists cut and burned the forest to clear land for crops and pasture. As the population grew (the first census, made in 1790, showed 378,787 persons), land-clearing continued.

Land-clearing went on at a fast pace until about 1825. By then industries had become established where waterpower was available, and cities had begun to grow. Railroads pushed into New England, and the competition of more cheaply produced western crops became too great for some Massachusetts farmers: land-clearing slowed down and stopped. By about 1850 farms were being abandoned and allowed to revert to forest. Pure stands of old-field white pine date from this period.

Forest industries by 1900 were using more than 100 million cubic feet of timber products annually. Before 1910 local production of timber products had begun to decline. In the last 20 years or so it has remained fairly steady but

[4] U. S. Bureau of the Census and U. S. Bureau of Old Age and Survivors Insurance. County Business Patterns, first quarter 1953, Part I, U.S. Summary. 214 pp. 1955.

at only about one-third the output of 50 years ago. Sawmilling has always been the principal forest industry. The pulp, cooperage, and other industries that use local logs and bolts are small.

In 1952, almost 21 million cubic feet of industrial timber products and almost 9 million cubic feet of fuelwood were cut from Massachusetts forests. Sawlogs accounted for almost two-thirds of the total output. Fuelwood production of about 112,000 standard cords represented 30 percent of the total, and the pulpwood output of 18,000 cords amounted to 5 percent. A small amount of cooperage, fence posts, and piling was also cut.

THE LUMBER INDUSTRY

There are more than 365 active sawmills in Massachusetts,[5] and almost two-thirds of them are stationary mills (fig. 1). The trend is toward fewer portable mills and more stationary mills. Even so, most of the sawmills are very small; a third of them produce less than 50 thousand board feet a year. There are 34 sawmills that produce more than 1 million board feet of lumber annually.

Lumber production in Massachusetts (fig. 2) rose to a peak of almost 385 million board feet in 1908 and then fell off to a low of 50 million board feet in the depression year 1933.[6] Salvage operations after the hurricane of 1938 caused lumber production to increase again. About 1 billion board feet of timber was blown down, and more than 300 million board feet of white pine was salvaged. Since 1939, annual lumber production has remained higher than 100,000,000 board feet because of the demands of the war and the post war building boom.

In 1952, sawmills in Massachusetts produced 130,000,000 board feet of lumber, 85 percent of it (110,000,000 board feet) from sawlogs harvested in local forests. More than 19,000,000 board feet of sawlogs were received at the mills from out-of-state sources. On the other hand, about 4,000,000 board feet of Massachusetts sawlogs were shipped out of the state (table 1). Softwood species accounted for three-fourths of the sawlogs cut and for

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[5] Massachusetts Department of Natural Resources, Division of Forests and Parks. List of sawmills by counties. 15 pp. 1955.

[6] Steer, Henry B. Lumber production in the United States, 1799-1946. U.S. Dept. Agr. Misc. Pub. 669. 233 pp. 1948.

about the same proportion of the lumber produced. The principal sawlog and lumber species is white pine.

This rate of production is far less than the lumber demands of Massachusetts' consumers. They must import from other states about ten times as much lumber as the sawmills in the state produce. The lumber freight bill alone is a sizable item. This large freight-cost advantage for local lumber producers is potentially a major incentive for growing more sawtimber closer to Massachusetts markets.

Much of the lumber sawed in Massachusetts is used in the manufacture of wooden boxes. This industry, using chiefly white pine, has been an important local industry for many years. In 1948 there were 61 wooden-box plants in operation, using nearly 160 million board feet of lumber.

Figure 1.--Most of the sawmills in Massachusetts are small. The trend is toward permanently located mills rather than portable mills.

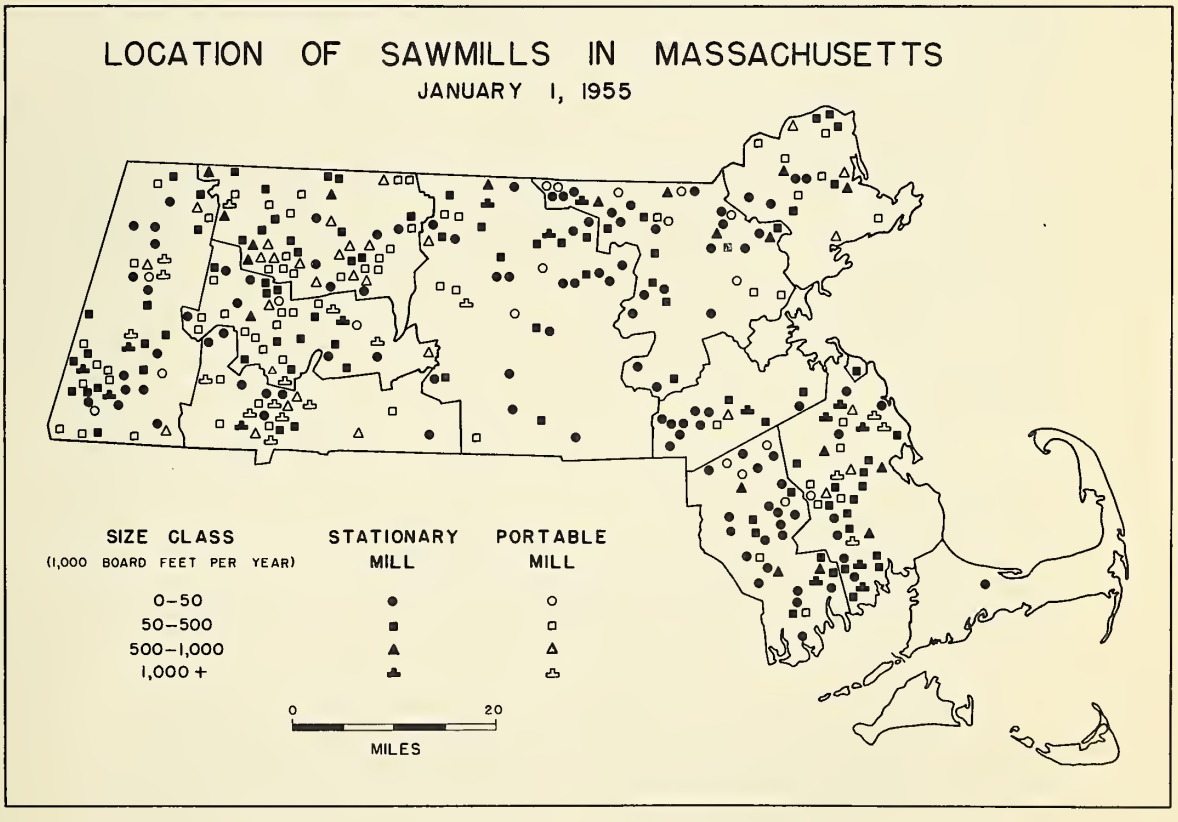

Table 1.--Sawlogs cut from Massachusetts forests, by species, 1952

Species	Volume cut[1]	
	Thousand bd.ft.	Percent
Softwoods:		
White and red pine	59,722	53
Hemlock	17,082	15
Spruce and fir	6,792	6
Other softwoods	149	(2/)
Total softwoods	83,745	74
Hardwoods:		
Oaks	11,231	10
Birch-beech-maple	10,059	9
Other hard hardwoods	2,153	2
Paper birch	3,210	3
Other soft hardwoods[3]	2,638	2
Total hardwoods	29,291	26
All species[4]	113,036	100

[1]Includes 4,306,000 board feet of sawlogs exported from Massachusetts.

[2]Less than 1 percent.

[3]Includes red maple, aspen, basswood, and yellow-poplar.

[4]Does not include 19,264,000 board feet of logs imported into Massachusetts.

Other lumber-using industries that depend partly on local lumber are the pallet and furniture manufacturers, the wooden toy industry, and a small boat-building industry along the coast. Some Massachusetts lumber is used in blocking and crating.

THE PULPWOOD INDUSTRY

Although there are two pulp mills in Massachusetts, their pulpwood requirements are small (fig. 3) and neither of them depends on Massachusetts timber. In 1952 all of their pulpwood, except for a few hundred cords, came from Canada and the northern New England States. Practically all the pulpwood cut in Massachusetts (about 18,000 cords in 1952) is shipped to pulp mills in Rhode Island and New York.

In contrast to the small size of the pulp industry, Massachusetts has a rather large paper industry. There are 83 paper mills, which use wood pulp and other kinds of pulp purchased outside the state. The paper industry has been

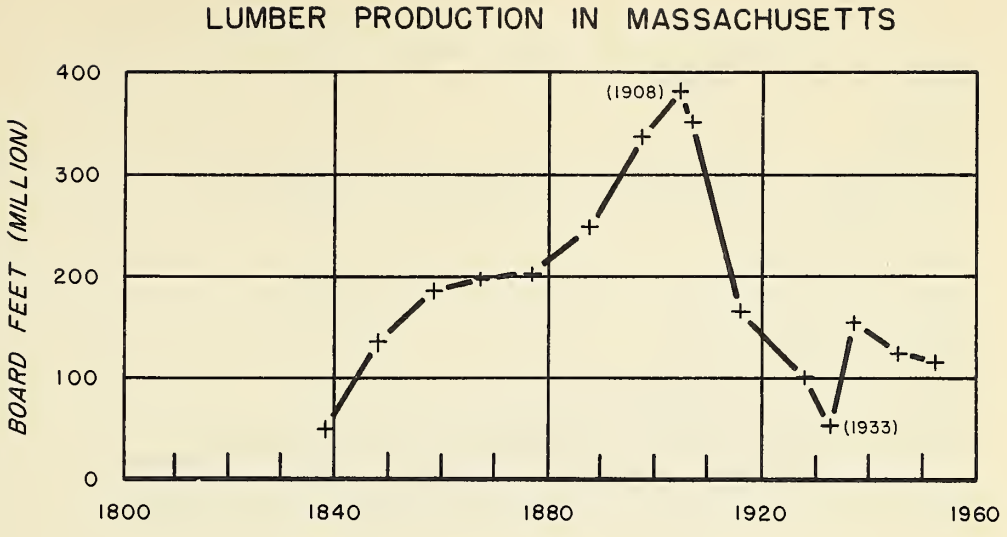

Figure 2.--The trend of lumber production in Massachusetts. Sawmills in the state produced some 130 million board feet of lumber in 1952.

well established in Massachusetts for more than 200 years. The state led the nation in paper production throughout most of the 19th century. Today it ranks 17th in output of paper and paperboard, and is one of the leading states in the production of fine writing papers and special industrial papers.[7]

OTHER FOREST INDUSTRIES

Three slack-cooperage mills manufacture butter tubs and fish pails, as well as a variety of souvenir products made of wood. The shingle, excelsior, and turning industries are each represented by one plant. A small amount of piling is also produced.

FUELWOOD

A surprisingly large amount of wood fuel is still burned in Massachusetts. In 1952 about 112,000 cords of

[7] U. S. Bureau of the Census. Facts for industry: Woodpulp, paper and board, 1953. 15 pp. 1955.

Table 2.--Output of timber products and annual cut of live sawtimber and growing stock, Massachusetts, 1952

Product	Output of timber products					Annual cut of sawtimber			Annual cut of growing stock		
	Volume in standard units		Round-wood volume								
			Soft-woods	Hard-woods	Total	Soft-woods	Hard-woods	Total	Soft-woods	Hard-woods	Total
	Units	Number	Thousand cu.ft.	Thousand cu.ft.	Thousand cu.ft.	Thousand bd.ft.	Thousand bd.ft.	Thousand bd.ft.	Thousand cu.ft.	Thousand cu.ft.	Thousand cu.ft.
Sawlogs	1,000 board feet[1]	101,744	13,982	4,934	18,916	59,256	22,556	81,812	14,151	5,442	19,593
Cooperage logs & bolts	"	519	3	121	124	286	15	301	122	3	125
Pulpwood	Standard cords[2]	[3]18,376	822	648	1,470	1,950	1,536	3,486	768	586	1,354
Fuelwood	"	[4]111,538	653	8,270	8,923	28	330	358	354	4,131	4,485
Piling	1,000 linear feet	25	2	13	15	9	72	81	2	14	16
Fence posts	1,000 pieces	147	73	27	100	9	3	12	67	22	89
Miscellaneous[5]	1,000 cubic feet	[6]30	16	14	30	66	40	106	17	15	32
Total	--	--	15,551	14,027	29,578	61,604	24,552	86,156	15,481	10,213	25,694

[1] International ¼-inch rule.
[2] Standard cords, rough wood basis.
[3] Does not include 19,000 cubic feet from plant residues.
[4] Does not include 2,605,000 cubic feet from plant residues.
[5] Includes shingles, split products, and chemical wood.
[6] Does not include 173,000 cubic feet from plant residues.

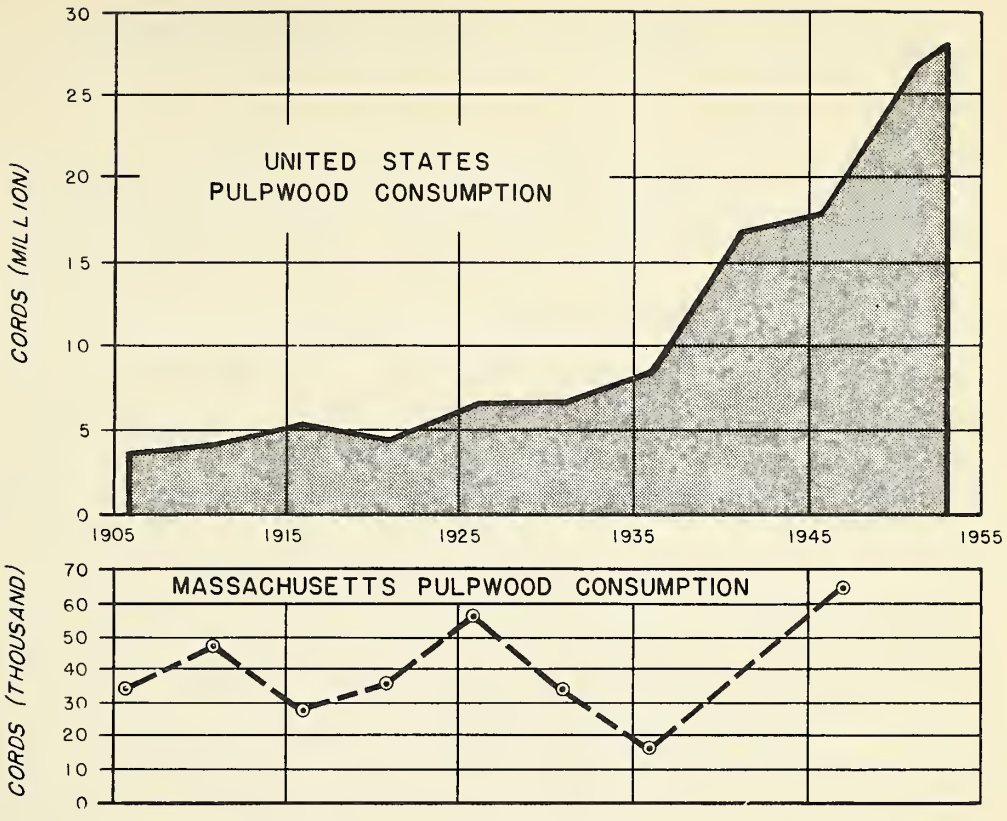

Figure 3.--The trend of pulpwood consumption in Massachusetts compared with national consumption.

round wood were used for fuel and about 32,000 additional cords were obtained from slabs, edgings, and other plant residues. Some 56,000 cords of the round fuelwood came from growing stock. A small part of the fuelwood, mostly slabwood, was used in making charcoal.

ANNUAL CUT OF GROWING STOCK

• The 1952 output of timber products, almost 30 million cubic feet, required a cut of about 26 million cubic feet of growing stock[8] (table 2). In addition, some 7 million cubic feet of timber products--almost half of this was for fuelwood--were obtained from cull trees, dead trees, hardwood limbs, and plant residues. On the other hand, almost 3 mil-

[8] See Appendix for definitions.

Table 3.--Net annual growth, annual mortality, and annual cut of live sawtimber and growing stock on commercial forest land, by species group, Massachusetts, 1952

Item	Sawtimber			Growing stock		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	Million bd.ft.	Million bd.ft.	Million bd.ft.	Million cu.ft.	Million cu.ft.	Million cu.ft.
Net annual growth	68	71	139	25	55	80
Annual mortality	9	4	13	8	8	16
Annual cut:						
Timber products	58	22	80	14	9	23
Logging residues	4	2	6	2	1	3
Total	62	24	86	16	10	26

Table 4.--Components of net annual growth of growing stock on commercial forest land by species group, Massachusetts, 1952

Item	Softwoods	Hardwoods	All species
	Thousand cu.ft.	Thousand cu.ft.	Thousand cu.ft.
Growth on growing stock	24,900	42,200	67,100
Ingrowth--saplings that became poletimber trees in 1952	8,700	21,400	30,100
Total	33,600	63,600	97,200
Annual mortality	8,400	8,300	16,700
Net annual growth	25,200	55,300	80,500

lion cubic feet of growing stock were cut but were left in the woods as waste. This logging residue consisted chiefly of volume in upper stems.

In terms of sawtimber volume, the 1952 cut was 86 million board feet. All but 5 percent of the sawtimber volume logged was for sawlog production. Most of the volume not used for sawlogs was made into pulpwood.

Thus, almost all the wood used by the forest industries is supplied from the growing stock; fuelwood is the only major product that is derived chiefly from other mate-

rial such as cull trees and sawmill residues. Less than a third of the volume cut for fuelwood comes from growing stock.

THE SUPPLY OF STANDING TIMBER

GROWTH EXCEEDS CUT

In sharp contrast to the 1952 cut of 26 million cubic feet of growing stock, the net growth was 80 million cubic feet (table 3). The harvest in 1952 was only one-third of the growth, chiefly because of the poor quality of the native timber and the relatively limited markets for hardwood.

The volume of sawtimber also increased during 1952. Although 139 million board feet were added to timber stands through sawtimber growth, only 86 million board feet were cut. The cut was 62 percent of the total board-foot growth.

Average annual losses due to fire, windthrow, insect and disease damage, and suppression were deducted to obtain these net-growth estimates. (No specific deductions were made in this report for the estimated loss of 50 million board feet, mostly white pine, due to hurricanes Carol and Edna in 1954. However, mortality was calculated on an average annual basis, so it includes some allowance for losses of this kind.) The volume of ingrowth (saplings that became poletimber or poletimber that became sawtimber during 1952) was included in the net annual growth estimates (table 4).

GROWTH-CUT RELATIONSHIPS VARY BY SPECIES

The volume of timber cut is much less than net annual growth. Although this over-all relationship is favorable, it must be qualified for species, tree-size class, and quality--especially quality. In terms of growing stock, the softwood cut is two-thirds of net growth, but the volume of hardwood cut is less than one-fifth (table 5).

White pine cubic-foot growth is about 50 percent more than the volume cut, and the cubic-foot growth of all other softwoods is more than double the volume cut. The cubic-foot growth of oaks is about four times the volume cut, and the cubic-foot growth of all other hardwoods is about eight times the volume cut.

For sawtimber trees, the cut is much closer to growth. In terms of sawtimber volume, the board-foot cut of softwoods is more than 90 percent of the net annual growth, but the board-foot cut of hardwoods is only one-third of their growth (table 6).

Table 5.--Annual cut and net annual growth of growing stock on commercial forest land, by tree-size class and species group, Massachusetts, 1952

Tree-size class and species group	Annual cut	Net growth
	Thousand cu.ft.	Thousand cu.ft.
Sawtimber trees:		
Softwoods	13,879	21,500
Hardwoods	5,226	16,100
	19,105	37,600
Poletimber trees:		
Softwoods	1,602	3,700
Hardwoods	4,987	39,200
	6,589	42,900
Sawtimber & poletimber trees:		
Softwoods	15,481	25,200
Hardwoods	10,213	55,300
Total[1]	25,694	80,500

[1]The annual cut of growing stock is equivalent to about 194,000 rough standard cords of softwoods and about 128,000 rough standard cords of hardwoods. Growth on growing stock is equivalent to about 315,000 rough standard cords of softwoods and about 691,000 rough standard cords of hardwoods.

Table 6.--Annual cut and net annual growth of live sawtimber on commercial forest land, by species group, Massachusetts, 1952

Species group	Annual cut	Net growth
	Thousand bd.ft.	Thousand bd.ft.
Softwoods	61,604	67,700
Hardwoods	24,552	71,200
Total	86,156	138,900

Table 7.--Net volume of all timber on commercial forest land, by class of material and species group, Massachusetts, 1953

Class of material	Softwoods	Hardwoods	Total
	Million cu.ft.	Million cu.ft.	Million cu.ft.
Growing stock:			
Sawtimber trees			
Sawlog portion	327	303	630
Upper-stem portion	46	110	156
Total	373	413	786
Poletimber trees	258	827	1,085
Total growing stock	631	1,240	1,871
Other material[1]:			
Sound cull trees	89	272	361
Rotten cull trees	4	96	100
Hardwood limbs	--	62	62
Total other material	93	430	523
Total, all timber	724	1,670	2,394

[1]The item "salvable dead trees" is not included here because the volume of this class of material in Massachusetts is insignificant.

The forests of Massachusetts are growing at an average rate of only 43 board feet per acre per year. This is divided almost half and half between softwoods and hardwoods. At the 1952 rate of cutting about 27 board feet per acre are harvested annually. Only 8 board feet per acre are cut from hardwood trees, but 19 board feet are cut from softwoods.

In general, hardwood trees are gradually taking over the forest land, replacing the more heavily cut softwoods. The average per-acre figures are low because about 40 percent of the forest land in Massachusetts has little or no timber on it.

FOREST GROWING STOCK

Growing stock is the volume of sound wood in the main stems of all sawtimber and poletimber trees, from a 1-foot stump to a 4-inch top inside bark. This volume is estimated to be about 1.9 billion cubic feet (table 7). More than one-half of it (58 percent) is found in poletimber trees. Since 0.5 billion cubic feet of sound wood--in cull trees and hardwood limbs--are not counted as forest growing stock, all

together there are 2.4 billion cubic feet of sound wood on the commercial forest land.

Because growing-stock trees are now or potentially merchantable for a wide variety of timber products, it is impossible to say how they will be used by any particular industry. For example, the sawlog portion of a sawtimber tree may be harvested for sawlogs or pulpwood or piling or some other product. A poletimber tree may be logged for pulpwood, posts, fuelwood, or even sawlogs--or it may be kept until it grows into a sawtimber tree.

SAWTIMBER VOLUME

The sawlog portions of sawtimber trees, amounting to 0.6 billion cubic feet of sound wood, account for one-third of the growing stock. Measured according to the International ¼-inch rule (which approximates lumber tally), this material is equivalent to about 2.7 billion board feet.

Table 8.--Net volume of live sawtimber and growing stock on commercial forest land, by species
Massachusetts, 1953

Species	Sawtimber[1]	Growing stock
	Million bd.ft.	Million cu.ft.
Softwoods:		
White pine[2]	858	344
Pitch pine	36	47
Hemlock	381	205
Other softwoods	24	35
Total	1,299	631
Hardwoods:		
White oaks	102	98
Northern red oak	405	357
Other red oaks	101	36
Yellow birch	42	50
Sugar maple	165	111
Soft maples	173	260
Beech	69	49
Ash	46	46
Paper birch	50	72
Sweet birch	36	42
Other hardwoods	171	119
Total	1,360	1,240
All species	2,659	1,871

[1] Log scale, International ¼-inch rule.
[2] Includes small amount of red (Norway) pine.

Table 9.--Net volume of live sawtimber and growing stock on commercial forest land, by stand-size class and species group, Massachusetts, 1953

Stand-size class and species group	Saw-timber	Growing stock
	Million bd.ft.	Million cu.ft.
Sawtimber stands		
More than 5,000 bd.ft. per acre:		
Softwoods	94	30
Hardwoods	184	71
1,500 - 5,000 bd.ft. per acre:		
Softwoods	620	244
Hardwoods	513	301
	1,411	646
Poletimber stands		
Softwoods	436	286
Hardwoods	559	764
	995	1,050
Seedling-and-sapling stands		
Softwoods	149	70
Hardwoods	102	103
	251	173
Nonstocked and other areas not elsewhere classified		
Softwoods	(1/)	1
Hardwoods	2	1
	2	2
All stands		
Softwoods	1,299	631
Hardwoods	1,360	1,240
Total	2,659	1,871

[1] Less than 500,000 board feet.

The sawtimber volume is evenly divided between the softwoods and the hardwoods (table 8). White pine makes up two-thirds of the softwood volume, and hemlock makes up most of the remaining third. The oaks, principally northern red oak, comprise almost half of the hardwood volume. Sizable volumes of sugar maple, soft maple, and beech are also to be found.

To the lumberman, it is highly significant that more than a third of the total board-foot volume is of species that are in slight demand by manufacturing industries. The oaks, for example, which account for 23 percent of the inventory volume, represent only 10 percent of the total sawlog cut. On the other hand, white pine, which accounts for

Table 10.--Net volume suitable for pulpwood on commercial forest land, by species, Massachusetts, 1953

Species	Suitable for pulpwood[1]	Species	Suitable for pulpwood
	Thousand cords		Thousand cords
Softwoods:		Hard hardwoods:	
White pine	3,738	White oaks	1,139
Hemlock	2,230	Northern red oaks	3,662
Pitch pine	511	Other red oaks	915
Others	381	Yellow birch	586
	6,860	Sugar maple	1,291
Soft hardwoods:		Beech	571
Soft maples	3,027	Ash	537
Paper birch	840	Sweet birch	490
Others	1,219	Others	172
	5,086		9,363
		All species	21,309

[1]In terms of the pulpwood specifications established by the Northeastern and Appalachian Technical Committees of the American Pulpwood Association. The total growing stock in Massachusetts represents about 23,400,000 cords, of which about 90 percent is suitable for pulpwood.

Table 11.--Quality of hardwood sawtimber on commercial forest land in Massachusetts, by species, 1953

(In millions of board feet)

Species	Standard-lumber logs			Tie and timber logs	Total
	Grade 1	Grade 2	Grade 3		
Northern red oak	24	61	138	182	405
Other oaks	8	36	55	104	203
Red maple	(1/)	21	55	97	173
Sugar maple	(1/)	33	83	49	165
Yellow birch[2]	10	14	28	26	78
Beech	4	7	30	28	69
Paper birch	3	5	22	20	50
White ash	3	5	20	18	46
Other hardwoods	6	46	66	53	171
All hardwoods	58	228	497	577	1,360
Percent	4	17	37	42	100

[1]None recorded on sample plots.

[2]Includes 36,000,000 board feet of sweet birch.

less than one-third of the inventory volume, makes up more than half of the sawlog cut.

Volume per acre (stand size) is another important factor that affects sawlog production. The average volume per acre of all sawtimber stands in Massachusetts is 3,600 board feet per acre. Many of the sawtimber stands contain barely enough sawtimber (1,500 board feet per acre) to rate as sawtimber stands. Loggers will not go into forest stands that have so little sawtimber unless the volume is in softwoods; therefore some of the sawtimber volume is in sawtimber stands that are not profitable to log under present conditions. Even more important than this, about 1.2 billion board feet of sawtimber (47 percent of the total) is scattered through poletimber stands and seedling-and-sapling stands that will be inoperable for sawtimber for some time to come (table 9).

Thus, only a portion of the sawtimber in Massachusetts is now merchantable. Less than half of the total board-foot volume is in the readily acceptable species, located in stands that loggers regard as operable timber. These operable stands are widely scattered about the state, and many are small in area.

VOLUME SUITABLE FOR PULPWOOD

About 90 percent of the growing stock volume--including most of the sawtimber and poletimber--meets regional specifications for pulpwood. This volume totals about 21 million cords. The softwood species represent one-third of the total volume suitable for pulpwood (table 10). Spruce, birch, beech, and maple are the species preferred for pulpwood in Massachusetts.

Stand class	Pulpwood volume
Cords	Thousand cords
0-5	2,891
5-15	11,344
15+	7,074
	21,309

More than 14 million standard cords of hardwood timber in the state are suitable for pulping. The hard-hardwood species--such as the oaks, sugar maple, and beech--account for 65 percent of it.

Like the lumberman, the pulpwood operator knows that only part of the total volume suitable for pulpwood can be harvested for that purpose. Some species are not desirable

at present. Much of the higher value material is used for lumber. Some of the timber is in stands that have less than 5 cords per acre. However, of the total suitable for pulpwood, more than 85 percent of the volume is located in operable stands of 5 or more cords per acre, and about one-third is to be found in stands of more than 15 cords per acre, including sawtimber volume.

TIMBER QUALITY

The quality of timber in Massachusetts is generally poor. Standard lumber logs (mostly grade 3) make up about 60 percent of the hardwood sawtimber volume; tie and timber logs account for the other 40 percent (table 11). In general, when a forest stand consists mostly of trees in the smaller diameter classes, there is only a very small proportion of the volume in high-quality material. In Massachusetts, 90 percent of the hardwood sawtimber trees are in the diameter classes of 10 to 18 inches.

White pine quality	
Log grade	Million bd. ft.
1	9
2	180
3	669

The poor quality of current timber supplies partially explains why growth exceeds cut. Although no exact estimates are available, there is little doubt that the cut of grade 1 and grade 2 sawlogs is somewhat greater than the net growth of such material.

Almost 80 percent of the white pine sawtimber is found in grade 3 sawlogs. Only 1 percent of the volume is estimated to be of grade 1 quality; 19 percent is grade 2. Again, although no exact estimates have been made in terms of quality, the cut in better grades is probably greater than the growth of such material.

CONDITION OF THE FORESTS

There are almost 3.3 million acres of forest land in Massachusetts (table 12). Practically all of it is commercial forest land. About 18,000 acres of productive forest land are reserved from timber cutting, mostly in watersheds and state county reservations. Another 11,000 acres of forest land are classed as unproductive, chiefly because of poor soil conditions.

Table 12.--Land area of Massachusetts, by major classes of land, 1953

Class of land	Area	
	Thousand acres	Percent
Forest:		
Commercial	3,259	65
Noncommercial:		
Productive but reserved	18	(2/)
Unproductive[1]	11	(2/)
Total	29	(2/)
Nonforest[3]	1,747	35
Total all classes	5,035	100

[1]Includes 200 acres withdrawn for special use.

[2]Less than 1 percent.

[3]Includes 22,000 acres of water according to forest survey standards of area classification but defined by the Bureau of the Census as land.

Table 13.--Land area and forest-land area of Massachusetts, by counties, 1915-28 and 1953

County	Total land area[1]	Area forested in 1915-28[2]		Area forested in 1953	
	Thousand acres	Thousand acres[3]	Percent	Thousand acres[4]	Percent
Barnstable	255,360	175,518	69	165,000	65
Berkshire	602,880	400,398	66	449,100	74
Bristol	355,840	226,240	64	224,900	63
Essex	320,000	148,718	46	138,200	43
Franklin	452,480	302,161	67	345,800	76
Hampden	397,440	268,963	68	263,400	66
Hampshire	337,920	236,141	70	229,100	68
Middlesex	530,560	341,287	64	311,200	59
Norfolk	254,720	166,571	65	144,300	57
Plymouth	424,960	304,133	72	292,100	69
Worcester	970,240	632,534	65	666,500	69
Dukes, Nantucket, & Suffolk	132,480	61,616	46	58,000	44
Total	5,034,880	3,264,280	65	3,287,600	65

[1]Census of Agriculture, 1950

[2]Cook, H. O. Jour. Forestry 27 (5): pp. 518-522. 1929.

[3]Includes abandoned fields and pastures coming up to brush and scattered tree growth, and referred to as transition land.

[4]Includes noncommercial forest land.

Table 14.--Area of commercial forest land, by major forest types, Massachusetts, 1953

Forest type[1]	Area		Forest type	Area	
	Thousand acres	Per-cent		Thousand acres	Per-cent
White pine:			Elm-ash-cottonwood:		
White pine	298	9	Ash-elm-maple	277	9
White pine-hardwood	149	5	Atlantic white-cedar	8	(2/)
Hemlock	115	3		285	9
Pitch pine	114	3			
Pitch pine-oak	51	2	Northern hardwoods:		
	727	22	Sugar maple-beech-yellow birch	470	14
			Hardwood-white pine-hemlock	43	1
Spruce-fir:			Hardwood-spruce-fir	50	2
Spruce-fir	22	1		563	17
Tamarack-black spruce	6	(2/)			
	28	1	Aspen-birch:		
			Aspen-gray birch	264	8
Oak:			Paper birch	21	1
Oak-pitch pine	46	1		285	9
Red oak	934	28			
Oak-white pine	221	7			
White oak	117	4	All types	3,259	100
Scrub oak	27	1			
Chestnut oak	19	1			
Eastern redcedar	7	(2/)			
	1,371	42			

[1]Forest types have been grouped to facilitate summarizing major forest types by states and regions.
[2]Less than 1 percent.

Table 15.--Area of forest types and net volume of sawtimber and growing stock on commercial forest land, Massachusetts, 1953

Forest type	Area	Volume	
		Saw-timber	Growing stock
	Thousand acres	Million bd.ft.	Million cu.ft.
White pine types	447	721	336
Hemlock	115	271	156
Pitch pine types	165	20	30
Other softwood types	43	19	27
Red oak	934	400	434
Sugar maple-beech-yellow birch	470	713	434
Aspen-gray birch-paper birch	285	71	84
Ash-elm-maple	277	80	115
Oak-white pine	221	131	103
White oak	117	51	40
Other hardwood types	185	182	112
Total	3,259	2,659	1,871

Almost all the land area in the state (5 million acres) was originally covered by forests. Before the Civil War, perhaps 70 percent had been cleared for agriculture. In the last 100 years or so, as crop and pasture acreage slowly declined, the forest has gradually come back. By 1907, the forest land area (determined from town maps) was estimated at 1,973,000 acres--39 percent of the state's land area.[9] Today, forest areas comprise 65 percent of the total land area.

The first systematic forest survey of Massachusetts was started in 1915 by the Department of Conservation and was completed in 1928.[10] From this survey, the forest acreage by counties was determined. There is a remarkably close agreement between these estimates of forest acreage and the estimates by the Federal forest survey of 1953 (table 13).

OAK FORESTS ARE MOST EXTENSIVE

The most extensive type of forest cover is oak. Oak forests occupy two-fifths of all the commercial forest land (table 14). They are most common in the central and eastern part of the state (except Plymouth and Barnstable Counties), making up from one-half to three-fourths of the total forest area in each county.

In general, the oak types are characterized by smaller volumes of sawtimber than most of the other cover types. They average only 460 board feet per acre. Other hardwood forest types occupy more than one-third of the commercial forest land and average 860 board feet per acre (table 15).

White pine and other softwoods are scattered through some of the hardwood stands. However, stands in which white pine predominates cover only one-seventh of the commercial forest land. White pine and other softwood stands average better than 1,300 board feet per acre.

TIMBER VOLUME IS SPREAD UNEVENLY

Sawtimber stands of 1,500 or more board feet per acre are found on 12 percent of the forest land (table 16). Only

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[9] Rane, Frank Wm. State Forester of Massachusetts fourth annual report, 1907. 43 pp. Boston. 1908.

[10] Cook, H.O. A forest survey of Massachusetts. Jour. Forestry 27: 518-522. 1929.

Table 16.--Area of commercial forest land by forest type and stand-size class, Massachusetts, 1953

(In thousands of acres)

Forest type	Saw-timber stands	Pole-timber stands	Seedling-and-sapling stands and other areas	Total
White pine	96	119	83	298
White pine-hardwood	28	96	25	149
Other softwood types	70	132	121	323
Red oak	41	533	360	934
Sugar maple-beech-yellow birch	114	254	102	470
Aspen-gray birch-paper birch	--	58	227	285
Ash-elm-maple	7	124	146	277
Oak-white pine	5	144	72	221
Other hardwood types	34	97	171	302
All types	395	1,557	1,307	3,259
Percent	12	48	40	100

Table 17.--Net volume of live sawtimber on commercial forest land, by diameter-class group and species, Massachusetts, 1953

(In millions of board feet)

Species	Diameter-class group (in inches)						Total
	10	12	14	16	18	20+	
White pine	119	137	148	131	103	220	858
Hemlock	61	95	84	52	51	38	381
Other softwoods	24	17	10	9	--	--	60
	204	249	242	192	154	258	1,299
White oaks	--	29	21	18	(1/)	22	90
Northern red oak	--	113	142	48	43	59	405
Other red oaks	--	39	25	21	9	7	101
Yellow birch	--	13	15	(1/)	9	5	42
Sugar maple	--	55	35	24	43	8	165
Beech	--	21	26	13	9	(1/)	69
Soft maples	--	66	50	29	23	5	173
Ash and basswood	--	32	30	24	13	23	122
Other hardwoods	--	70	67	25	19	12	193
	--	438	411	202	168	141	1,360
All species	204	687	653	394	322	399	2,659

1/ No trees in this class were tallied on sample plots.

1 percent of the forest area has stands of more than 5,000 board feet per acre. The sawtimber stands carry a little more than half of the total sawtimber volume and a little more than one-third of the growing stock. Poletimber, sapling, and other stands--covering 88 percent of the forest land--carry the remaining two-thirds of the growing stock. The poletimber area, nearly half of the total, is unusually large. This is possibly due to the loss of large amounts of sawtimber in the 1938 and 1944 hurricanes.

The white pine forest type has the largest percentage of its area in sawtimber stands. These sawtimber stands amount to 32 percent of the area in the white pine type. The sugar maple-beech-yellow birch type has 24 percent of its area in sawtimber stands. More than three-fourths of the board-foot volume of these two forest types are in sawtimber stands.

SMALL TREES PREDOMINATE

More than half of the softwood sawtimber volume is found in trees in the smaller diameter classes: 10, 12, and 14 inches d.b.h. Even more striking than this is the fact that over 60 percent of the hardwood sawtimber volume is found in the two smaller diameter classes, 12 and 14 inches (table 17).

Of total growing stock (trees in the 6-inch and larger diameter classes), a little more than half the volume is in poletimber trees. Almost 74 percent of the softwood growing-stock volume is found in trees of the 14-inch and smaller diameter classes, but 88 percent of the hardwood growing stock volume is found in those classes (table 18).

In terms of numbers of trees included in the growing stock, there are about three times as many softwood poletimber trees as there are softwood sawtimber trees and about 10 times as many hardwood poletimber trees as there are hardwood sawtimber trees (table 19).

MOST OF THE FOREST IS PRIVATELY OWNED

Private owners hold 88 percent of the commercial forest land in Massachusetts, 87 percent of the growing stock volume, and 91 percent of the sawtimber volume (tables 20 and 21). Farm forests, covering 740,000 acres, account for nearly one-fourth of the forest land area. Forest industry ownerships include some 259,000 acres of commercial forest land, about 8 percent of the area.

Table 18.--Growing stock on commercial forest land, by diameter-class group and species group, Massachusetts, 1953

(In millions of cubic feet)

Species group	Diameter-class group (in inches)					Total
	6	8-10	12-14	16-18	20+	
Softwoods	98	212	156	98	67	631
Hardwoods	239	580	276	106	39	1,240
All species	337	792	432	204	106	1,871
Percent	18	42	23	11	6	100

Table 19.--Present and potential growing stock trees on commercial forest land, by diameter class and species group, Massachusetts, 1953

Diameter class (inches at breast height)	Softwoods	Hardwoods	All species
	Millions of trees	Millions of trees	Millions of trees
Saplings:			
2	212	757	969
4	118	245	363
	330	1,002	1,332
Poletimber:			
6	51	103	154
8	27	54	81
10	--	28	28
	78	185	263
Sawtimber:			
10	11	--	11
12	6	10	16
14	4	5	9
16	2	2	4
18	1	1	2
20+	1	1	2
	25	19	44
All trees	433	1,206	1,639

Table 20.--Commercial forest-land area, by ownership and stand-size classes, Massachusetts, 1953

(In thousands of acres)

Ownership class	Total area	Saw-timber stands	Pole-timber stands	Seedling-and-sapling stands	Nonstocked areas
Public:					
Federal	29	(1/)	8	21	(1/)
State	280	30	156	91	3
County and municipal	90	4	54	31	1
Total	399	34	218	143	4
Private:					
Farm	740	54	371	307	8
Forest industry and other private	2,120	307	968	821	24
Total	2,860	361	1,339	1,128	32
All ownerships	3,259	395	1,557	1,271	36

[1]Less than 500 acres.

Table 21.--Net volume of live sawtimber and growing stock on commercial forest land, by ownership class, Massachusetts, 1953

Ownership class	Saw-timber	Growing stock
	Million bd.ft.	Million cu.ft.
Federally owned or managed	14	11
State	214	188
County and municipal	21	43
Private:		
Farm	615	451
Forest industry and other private	1,795	1,178
Total private	2,410	1,629
All ownerships	2,659	1,871

More than half of the forest-land area (1,861,000 acres) belongs to private owners who are neither industrial nor farm owners. These "other" private ownerships are also the most numerous; they account for 70 percent of all private forest properties:

Ownership type	Number[11]
Farm	8,697
Forest industry	134
Other private	20,927
	29,758

About 30 percent of the private holdings are farm forests and less than 1 percent are owned by the forest industries.

Despite their prominence in the forest-ownership pattern, little is known about the characteristics of these "other" private owners. The only available information comes from a study, completed in 1949, of forest ownership in 23 New England towns.[12] Four of the towns--Plympton, Deerfield, Tyringham, and Mt. Washington--are in Massachusetts. In these towns 319 forest owners were identified, of whom 90 were farmers and 7 were sawmill or wood-using-industry owners. The remaining 222 owners--all in the "other" private category--were classified as follows:

Class of owner	Number	Acres held
Business or professional	78	12,359
Laborer or clerical	31	1,067
Dealer in land or stumpage	7	381
Housewife	41	2,834
Retired	39	3,841
Recreational establishment	2	244
Bank or other financial institution	2	591
Public utility or other industrial	4	427
Club or instituion	2	465
Unsettled estate	11	707
Student	5	317
Total	222	23,236

[11] Excluding ownerships of less than 3 acres of commercial forest land.

[12] Barraclough, Solon L. Forest land ownership in New England. With special reference to forest holdings of less than five thousand acres. Unpublished thesis, Harvard University. 269 pp., illus. 1949.

Similar diversity was found in other characteristics of these owners, particularly in their reasons for owning forest land. Many of them held their property for recreational or residential purposes, for speculation, or simply because the owner derives satisfaction from owning land. Very few of these properties are tax delinquent.

Excluding forest properties of less than 3 acres, about 85 percent of the private ownerships are less than 100 acres in size (table 22). They account for 38 percent of the State's commercial forest land. Only five holdings are larger than 5,000 acres.

PUBLIC OWNERSHIPS LARGELY STATE FORESTS

Twelve percent of the commercial forest land is publicly owned, of which the Commonwealth of Massachusetts owns more than two-thirds, or 280,335 acres, classed as follows:

State-owned forest land	Acres
State forests	168,870
State parks	3,217
Reforestation lots	1,393
Fish and Game	1,678
State County Reservations	11,689
Univ. of Massachusetts	1,955
Other schools	600
Metropolitan District Commission	80,649
Mental Health and Welfare	10,284
Total forest land	280,335

The Division of Forests and Parks administers 71 state forests, 12 state parks, and a number of reforestation lots. These three classes of forest land account for 173,480 acres (fig. 4).

About 29,000 acres are in Federal ownership, mainly in military installations. Towns and cities have acquired 88,000 acres, often to protect their water supplies. There are more town forests in Massachusetts than in any other New England state. County ownership is negligible.

FOREST OPPORTUNITIES IN MASSACHUSETTS

More than 3 million acres of Massachusetts land support forest growth. Timber products of good quality are

readily marketable. Excellent transportation facilities are available. Protection of the forests from fire and other destructive agents is better than average. A measure of relief from burdensome taxation is available through the forest land-classification and yield-tax laws. These favorable factors indicate that the growing of a larger volume of timber of higher quality is feasible.

Table 22.--Commercial forest-land area in private ownership and number of private owners, by size class of ownership, Massachusetts, 1953

Ownership size class (in acres)	Owners	Area
	Number	Thousand acres
Private:		
3 to 100	25,175	1,238
100 to 500	4,316	1,262
500 to 5,000	262	301
5,000 and larger	5	59
Total, private	29,758	2,860
Public	--	399
Total	29,758	3,259

The 30,000 private forest owners in Massachusetts represent a wide range of interests. The forest industry owners obviously depend on timber supplies, but they number less than 150 and control less than 10 percent of the commercial forest area. The farm and other private owners, who hold 80 percent of the area, seem to have many reasons other than timber values for owning forest land. Most of these ownerships--particularly those of 100 acres and more--can be managed for timber production with little or no conflict with other owner interests.

In the past, most private owners have been neither willing nor able to invest in cultural measures or to forego immediate income in favor of future growth. Although noteworthy improvements in private forestry have been made, even the favorable timber markets of the postwar years have not brought about a widespread change in owner attitudes. Few owners are aware of the tremendous expansion in timber-products demand that is apparently in the offing.

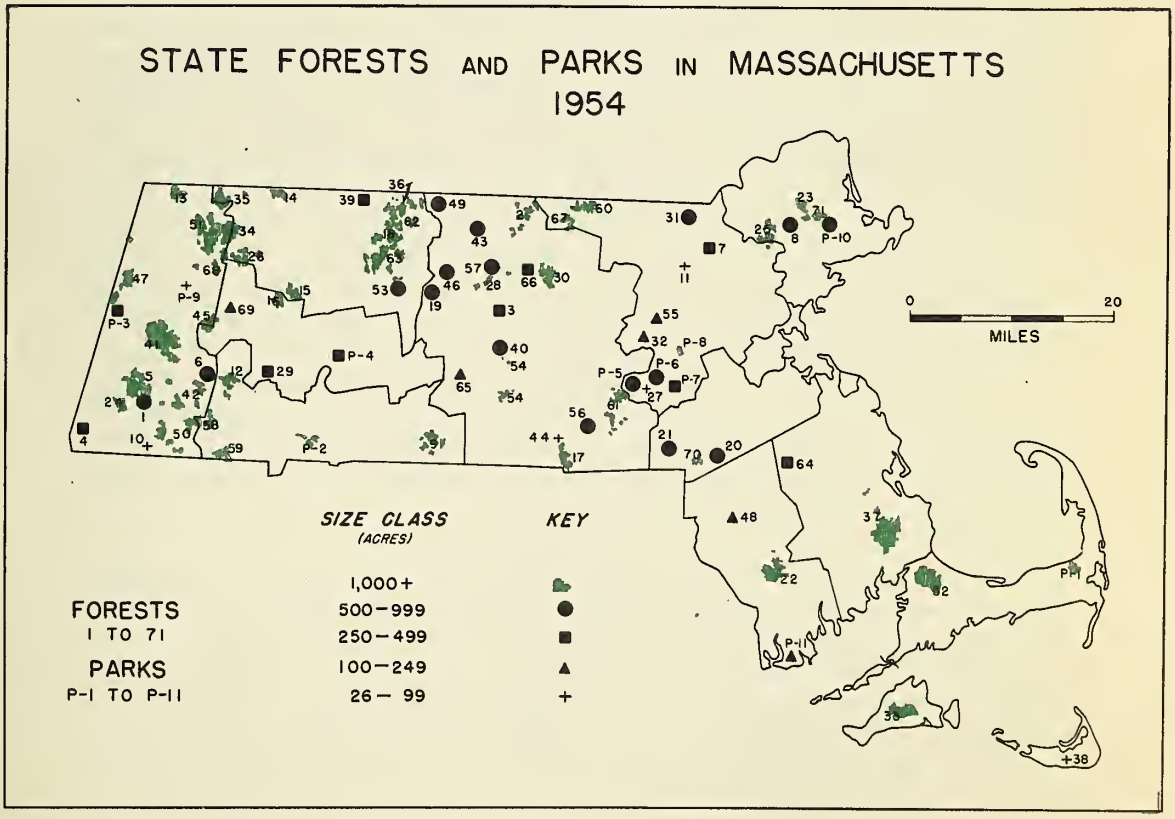
Yet the timber resource contributes very little to the economy of Massachusetts. The forest survey shows that

the level of growing stock is extremely low. Quality, stocking, and species composition of the stands show little evidence of careful management.

The reasons for this situation are many. Despite an abundance of cheap timber in other regions, heavy cutting was long continued in Massachusetts. Hurricanes have been very destructive. Much land reverted from farmland to forest without benefit of good seed sources. Much of the area still supports very young stands; half of the forest land area is still in the process of reverting from formerly cleared land to climax timber types. Forest protection is of fairly recent origin.

A long time will be required to obtain substantial increases in sawtimber supplies. But, more than ever before, there are now opportunities for raising income from forest land, for increasing timber-based employment, and for expanding returns to forest industries.

Figure 4.--The Commonwealth of Massachusetts owns 280,335 acres of commercial forest land, most of it in state forests.



NATIONAL GROWTH MEANS NEW MARKET OPPORTUNITIES

The change in the timber-growing outlook for Massachusetts is due chiefly to the change in prospective timber-products demand. Over the last two decades timber prices have risen much more rapidly than timber consumption and much more rapidly than other commodity prices. Nationally, a greatly increased population and a greatly expanded economy are anticipated.

In contrast to markets for softwood and high-grade hardwood sawlogs, market outlets for low-grade hardwood are admittedly scarce in Massachusetts. Massachusetts is well located with respect to consumer markets, yet much Massachusetts timber is unattractive to buyers because of its low quality and small size. However, this problem is not peculiar to Massachusetts alone. Low-value hardwoods are surplus in many of the other states in the Northeast. With increasing demand for paper and other forest products, it is reasonable to expect that more low-grade timber will be used. As technological improvements are made in conversion processes, new markets also may appear.

If forest owners accept better prices and markets as an opportunity for practicing more intensive forest management, there is no reason why Massachusetts forests cannot be made considerably more productive. In most instances, larger outlays for silvicultural measures will be more than offset by greater yields of higher quality material. In immature stands, recreational and esthetic values are preserved better by planned light cuttings than by haphazard heavy cuttings.

SAWTIMBER VOLUME CAN BE INCREASED

Opportunities for forestry are most apparent where there are sawtimber stands to work with. In these stands carefully planned harvest cutting will result in better growth and regeneration as well as immediate financial returns for the landowner.

Unfortunately Massachusetts has a relatively small area of sawtimber. Only 1 percent of the forest area carries more than 5,000 board feet per acre. Stands of 1,500 or more board feet per acre occupy 12 percent of the forest land. Many of them carry enough timber that commercial thinnings and improvement cuttings could be made. In such stands foresters can mark the trees to be cut so that the growth and quality of the residual trees will be increased.

If the logging is done carefully, sawtimber growth will increase and frequent periodic cuts can be made for many years to come.

Prior to the actual cutting of timber, Massachusetts owners are required to notify the State Division of Forestry of their intention to cut. Upon notification, the Division of Forestry seeks out the owner and advises him of the minimum cutting practice standards set up by the State Forestry Committee. The law requires loggers to observe the minimum standards or be subject to a fine of not more than $25.

In the 8 years prior to 1953, while all types of cutting practices were permissible, state district foresters and farm foresters received nearly 4,000 notices of cutting intentions, made more than 2,000 plans for owners, and helped to introduce the practices of forestry on more than 100,000 acres. If more loggers follow the minimum cutting standards, and particularly if a large share of them take steps to raise their level of cutting practice above the minimum, Massachusetts can look forward to steadily increasing supplies of valuable sawtimber.

TIMBER QUALITY CAN BE IMPROVED

Although sawtimber quality is generally poor, the tree species that commonly grow in Massachusetts are potentially capable of supplying timber products of highly satisfactory quality. Quality is poor partly because a large acreage of forest stands is in the process of reverting from open land, and some of the sawtimber volume is in remnant trees scattered through poletimber and younger stands. Furthermore, in white pine stands, particularly in old-pasture stands, weevil damage and poor stocking have resulted in excessive branchiness and extremely knotty wood. However, the chief explanation of poor quality is the small size of the average sawtimber tree.

Tree quality can be improved, therefore, by letting the trees grow, and by stand improvement. The opportunity is perhaps greatest in the poletimber stands. There are 1½ million acres of such stands, most of them in the oak, northern hardwood, and other hardwood types. Many hardwood poletimber trees are of sprout origin, poorly formed, and infected with heart rot from the parent stump. It is possible to reduce the number of stems in the sprout clumps, and to girdle or poison the stems of poor form ("wolf trees") or those heavily damaged by rot in order to favor the best-formed trees as crop trees for future growth.

Where low-grade material can be sold, landowners will find it possible to improve their poletimber without additional investment. In other areas new outlays for cultural measures will be necessary. With the new tools, techniques, and incentives for stand improvement that have recently appeared, and with the prospect of better prices for higher quality timber, many landowners may find here an opportunity that has not existed before.

Similar opportunities for quality improvement may be found in the white pine areas. Where the market for round-edged box boards is good, owners are finding it possible to dispose of the more limby trees in their younger stands. Clear white pine lumber always commands a premium price. Since white pine does not shed its branches at an early age, it is necessary to invest in some pruning of crop trees where high-quality wood is desired in the first (or even second) log. Best results will be obtained where limbs are removed in several stages when the stem is less than 6 inches in diameter. Pruning alone is seldom a satisfactory measure unless the growth rate is also maintained by careful liberation cuttings and thinnings. Landowners can obtain advice on pruning and other cultural measures from the extension forester, district foresters, or consulting foresters.

BETTER STOCKING CAN BE ACHIEVED BY PLANTING AND PROTECTION

Although nearly 100,000 acres have been planted to trees, there are still more than 35,000 acres of nonstocked forest land in Massachusetts and about the same acreage of poorly stocked forest areas--much of it occupied by brush. Much of the planting done in the past has been on abandoned fields and pastures. Poorly stocked stands, cutover areas, and burned areas have received less attention. Some 700 acres are planted each year with stock provided from forest tree nurseries at Amherst, Bridgewater, and Clinton. Practically all of the planted trees are softwoods.

In all, there are about 100,000 acres of forest and nonforest land where planting is considered advisable, including most of the nonstocked and poorly stocked forest area mentioned above. Over much of this plantable area, timber production is only one of the reasons for planting. Watershed protection, prevention of soil erosion, provision for wildlife cover, and scenery are equally important reasons.

Large gains have been made in forest protection. Although the average annual number of forest fires has not

changed materially in the last 40 years, there has been a big reduction in the number of acres burned and the amount of fire damage (table 23). Sizable sums have been spent for control of the gypsy moth. Better protection has helped greatly to bring about better stocking, and no doubt a large part of the present surplus of growth over drain can be traced to this activity.

Table 23.--Average annual fire statistics for Massachusetts, 1910-1914 and 1950-1954

Item	Unit	Average[1] 1910-1914	Average[2] 1950-1954
Forest fires	number	2,292	2,405
Area burned	acres	51,359	9,054
Average area per fire	acres	22.4	3.8
Forest fire damage	dollars	219,542	82,746

[1]Data from 16th Annual Report of the State Forester of Massachusetts. Public Doc. No. 73. 1922.

[2]Data from mimeographed fire report summaries by the Massachusetts Division of Forests and Parks.

Yet there remain many opportunities for raising the productivity of the forest land through better stocking. Over large areas much of the growing space is occupied by cull trees. Where cull trees can be cut or killed, the stand can gradually be stocked with better trees through natural regeneration. Except where desirable seed sources are entirely lacking, this is the best way of insuring good stocking of the better species and stems. Various silvicultural cuttings will also help to bring about adequate reproduction over a period of time. Such measures, plus adequate cultural care of existing young stands and plantations, offer forest-land owners more opportunities than planting alone, though some planting may be desirable where adequate seed sources of desired species are unavailable.

MORE EFFICIENT MARKETING AND UTILIZATION IS POSSIBLE

For timberland owners the immediate opportunity lies in making better use of the markets that already exist. Owners who have timber to sell can increase their returns by making sure that they know how much timber they have to sell, by determining the prices and specifications of markets that will take the products, by selling products for their highest use, and by seeking out reputable bidders.

Owners can obtain marketing information from district foresters and the extension forester. They can handle sales themselves, with the help of these public foresters, or they can turn the job over to consulting foresters.

Although closer utilization hinges upon the development of more diversified market outlets, there are many ways in which timber utilization could be improved today. Most tree species are suitable for a variety of timber products. The sawlog portion of a sawtimber tree may be suitable for sawlogs or veneer logs, cooperage bolts, poles, or piling. Upper stems and small trees can be used for pulpwood, posts, or fuelwood.

The opportunity for timber owners and loggers as well as for the forest industries lies in putting each product to its highest use. The need is for integrated utilization in the woods and at the manufacturing plants whenever it is economically possible. Bucking trees so as to obtain the highest possible log grade is one example of what might be done. Sawlogs can be debarked profitably by sawmills that saw 2 million or more board feet per year. Slabs and other bark-free residues can be manufactured or sold as byproducts.

APPENDIX

DEFINITIONS OF TERMS

FOREST AREA

Forest-land area.--Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking and which has not been developed for other use; and (c) afforested areas. Forest tracts of less than 1 acre, isolated strips of timber less than 120 feet wide, and abandoned fields and pastures not yet 10 percent stocked with trees are excluded.

Commercial forest-land area.--Forest land that is (a) producing, or physically capable of producing, usable crops of wood (usually sawtimber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization.

Noncommercial forest-land area.--Forest land (a) that has been withdrawn from timber utilization through statute, ordinance, or administrative order but that otherwise qualifies as commercial forest land, or (b) is incapable of yielding usable wood products (usually sawtimber) because of adverse site conditions.

FOREST COVER TYPES

Forest types are determined upon the basis of predominant species as indicated by cubic volume for sawtimber and poletimber stands, and number of trees for seedling-and-sapling stands. Where no one species makes up 50 percent or more of a given stand, the stand is typed on the basis of plurality of cubic volume or number of trees. All types are keyed to these major forest-type groups:

White-red pine.--Forests in which 50 percent or more of the stand is eastern white pine or red pine, singly or in combination. Common associates include hemlock, aspen, birch, and maple. This includes the temporary pitch pine forest type, in which pitch pine makes up 50 percent or more of the stand.

Spruce-fir.--Forests in which 50 percent or more of the stand is spruce or true firs, singly or in combination. Common associates include white-cedar, tamarack, maple, birch, and hemlock.

Oak.--Forests in which 50 percent or more of the stand is in upland oaks or hickory, singly or in combination, except where pines comprise 25 to 49 percent, in which case, the stand would be classified as oak-pine. Common associates include yellow-poplar, elm, maple, and black walnut. Includes a small acreage of the oak-pine forest type, in which pitch pine makes up 25 to 49 percent of the stand.

Elm-ash-cottonwood.--Forests in which 50 percent or more of the stand is elm, ash, or cottonwood, singly or in combination. Common associates include willow, sycamore, beech, and maple.

Northern hardwoods.--Forests in which 50 percent or more of the stand is maple, beech, or yellow birch, singly or in combination. Common associates include hemlock, elm, basswood, and white pine.

Aspen-birch.--Forests in which 50 percent or more of the stand is aspen, balsam poplar, paper birch, or gray birch, singly or in combination. Common associates include maple and balsam fir.

STAND-SIZE CLASSES

Sawtimber stands.--Stands with sawtimber trees that have a minimum net volume per acre of 1,500 board feet, International $\frac{1}{4}$-inch rule.

Poletimber stands.--Stands that fail to meet the sawtimber stand specification but are at least 10 percent stocked with poletimber and larger trees (5.0 inches d.b.h. and larger), and have at least half of the mimimum stocking in poletimber trees. Poletimber stands carry at least 200 cubic feet per acre.

Seedling-and-sapling stands.--Stands that do not qualify as either sawtimber or poletimber stands but have at least 10 percent stocking of trees of commercial species and have at least half the minimum stocking in seedling-and-sapling trees.

Nonstocked and other areas not elsewhere classified.--Areas that do not qualify as sawtimber, poletimber, or seedling-and-sapling stands.

TREE CLASSES

Sawtimber trees.--Trees of commercial species that contain at least one merchantable sawlog, as defined below, and that are of the following minimum diameters at breast height (d.b.h.): softwoods 9.0 inches and hardwoods 11.0 inches.

Poletimber trees.--Trees of commercial species that meet regional specifications of soundness and form and are of the following diameters at breast height: softwoods 5.0 inches to 9.0 inches; hardwoods 5.0 to 11.0 inches. Such trees will usually become sawtimber trees if left to grow.

Seedling-and-sapling trees.--Live trees of commercial species less than 5.0 inches in diameter at breast height and of good form and vigor.

Cull trees.--Live trees of sawtimber or poletimber size that are unmerchantable for sawlogs now or prospectively because of defect, rot, or species.

Pulpwood trees[13].--Live trees of commercial species, 5.0 inches d.b.h. and larger, that contain at least two contiguous pulpwood bolts and have 50 percent or more of the main stem volume usable for pulpwood. Most of the sawtimber and poletimber trees are also pulpwood trees.

TIMBER VOLUME

Growing stock.--Net volume in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top of central stem, inside bark.

Net volume in cubic feet.--Gross volume less deductions for rot.

Live sawtimber volume.--Net volume in board feet, International $\frac{1}{4}$-inch rule, of live sawtimber trees of commercial species. Sawtimber volume is measured in 16-foor merchantable sawlogs except that the uppermost merchantable sawlog may be as short as 8 feet.

Net volume in board feet.--Gross volume in terms of the International $\frac{1}{4}$-inch log rule less deductions for rot, sweep, and other defects that affect use for lumber.

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[13] As defined by the Northeastern and Appalachian Technical Committees of the American Pulpwood Association.

Pulpwood volume[13].--Net volume in standard cords, including bark, of the main stem of pulpwood trees from stump to a point where the top breaks up into branches, unless a minimum top diameter of 4.0 inches, inside bark, is reached first. Pulpwood volume is measured in 4-foot bolts, having a minimum continuous length of 8 feet.

Net volume in standard cords.--Gross volume in terms of the standard rough cord less deductions for rot, sweep, and other defects that affect use for pulpwood. Cord estimates are derived from cubic-foot measurements by applying a factor of 80 cubic feet of wood, inside bark, per standard cord, outside bark.

TIMBER QUALITY

Merchantable sawlogs.--Sections of tree bole that meet one of the following sawlog specifications:

Hardwood sawlogs are sections of the main stem of hardwood trees of commercial species that meet one of the grade specifications for standard lumber logs[14] or, failing to do so, qualify as tie and timber logs[15] (fig. 5 and fig. 6).

Softwood sawlogs are sections of the main stem of softwood trees that meet the minimum grade specifications developed by the New England Timber Salvage Administration, U. S. Forest Service. White pine log grades are shown in figure 7.

Other softwood sawlogs are sections of the main stem of softwood trees, except white pine, that are at least 6.0 inches in top diameter and at least 8 feet long. Spruce, fir, and hemlock sawlogs meet the minimum grade specifications developed by the New England Timber Salvage Administration, U. S. Forest Service.

Pulpwood bolts[13].--Sections of the main stem of trees of commercial species, 4 feet long; 4.0 inches or more in diameter inside bark at the small end; free from any indication of rot, charred wood, tramp metal, or hollow center; and contiguous to one or more sections meeting these same requirements. Crotches are excluded; sweep or crook in any

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[14]U.S. Forest Products Laboratory. Hardwood log grades for standard lumber. Proposals and results. U. S. Forest Prod. Lab. Rpt. D1737. 15 pp., illus. Madison, Wis. 1949.

[15]Southern Forest Experiment Station. Interim log grades for southern hardwoods. U.S. Forest Serv. South. Forest Expt. Sta. 9 pp. New Orleans. 1948.

HARDWOOD LOG GRADES FOR STANDARD LUMBER

GRADE FACTORS*		SPECIFICATIONS: Log Grade 1			Log Grade 2				Log Grade 3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Minimum diameter (inches)		[1]13-15	16-19	20+	[2]11	12+			8+
Minimum length (feet)		10+	10+	10+	10+	8-9	10-11	12+	8+
Clear cuttings** on each of the 3 best faces	Min. length (feet)	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	—
	Min. yield in face length	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Max. sweep and crook allowance (percent of gross volume)		15			30				50
Max. cull and sweep allowance (percent of gross volume)		[3]40			[4]50				50

*End defects, although not visible in standing trees, are important in grading cut logs. Instructions for dealing with this factor are contained in Forest Prod. Lab. Rpt. D1737.

**A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth the surface of the log as divided lengthwise.

[1]Ash and basswood butts can be 12 inches if otherwise meeting requirements for small No. 1's.

[2]10-inch logs of all species can be No. 2 if otherwise meeting requirements for small No. 1's.

[3]Otherwise No. 1 logs with 51-60 percent cull can be No. 2.

[4]Otherwise No. 2 logs with 51-60 percent cull can be No. 3.

Figure 5.--The hardwood log grades used as standards in the forest survey of Massachusetts.

section disqualified the bolt if an imaginary line through the bolt from center of top cut to center of bottom cut passes outside the wood at any point.

GROWTH AND DRAIN

Net annual growth of sawtimber.--The change during a specified year in net board-foot volume of live sawtimber on

HARDWOOD LOG SPECIFICATIONS
FOR TIES AND TIMBERS

GRADE FACTORS		SPECIFICATIONS
Position in tree		Butts and uppers
Scaling diameter (inches)		8+
Length, without trim (feet)		8+
Clear cuttings		No requirements: not graded on cutting basis.
Max. sweep allowance		One-fourth d.i.b. of small end for half logs, and one-half d.i.b. for logs 16 feet long.
Sound surface defects permitted	Single knots	Any number, if none has an average collar* diameter that is more than one-third of log diameter at point of occurrence
	Whorled knots	Any number, provided the sum of the collar diameters does not exceed one-third the log diameter at point of occurrence.
	Holes	Any number not exceeding knot specifications if they do not extend more than 3 inches into the contained tie or timber.
Unsound surface defects** permitted	Any number and size if they do not extend into contained tie or timber. If they extend into contained tie or timber, they shall not exceed size, number, and depth of limits for sound defects.	

*Knot collar is the average of the vertical and horizontal diameters of the limb or knot swelling as measured flush with the surface of the log.

**Interior defects are not visible in standing trees. They are considered in grading cut logs. No interior defects are permitted except one shake not more than one-third the width of the contained tie or timber, and one split not more than 5 inches long.

Figure 6.--The standards for hardwood tie and timber logs.

commercial forest land resulting from natural causes.

Net annual growth of growing stock.--The change during a specified year in net cubic-foot volume of growing stock on commercial forest land resulting from natural causes.

Annual cut of live sawtimber.--The net board-foot volume of live sawtimber trees cut or killed by logging on commercial forest land during a specified year.

Annual cut of growing stock.--The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging on commercial forest land during a specified year.

FOREST SURVEY METHODS

Estimates of forest area, timber volume, and tree growth in Massachusetts are based on data obtained from aerial photographs and sample plots examined on the ground.

Each aerial photograph had two 1-acre circular plots printed on it by use of a multilith machine. There were 7,530 of these circular plots. Each plot was examined under a stereoscope and classified as forest or nonforest. Forest plots were classified further according to broad forest type, stand-size class, and density. These plots are commonly referred to as photo-interpretation plots or PI plots.

From the PI forest plots, 474 were selected at random for examination on the ground. In selecting these plots for field study, those stand-size classes containing the heaviest timber volume were sampled most intensively, while the lightest sample of forest plots was taken in the seedling-and-sapling stands and nonstocked areas. An accurate tally of all trees, by species and size class, was obtained on each field plot. These plots also provided a check on the accuracy of photo classification as well as data on volume, growth, and timber quality.

A number of PI nonforest plots were randomly selected for field examination to provide a check on the accuracy of the photo classification between forest and nonforest land.

Growth was computed from measurements of tree rings on increment cores taken from sample trees. These data were used in estimating the diameter distribution of each species group 10 years hence. Future volume was predicted from this new distribution of diameters. Growth was then determined by subtracting present volume from estimated future volume and reducing the difference to an annual basis. Allowances were made for mortality, ingrowth, and timber cut.

Estimates of timber cut in Massachusetts were based on production surveys and woods utilization studies conducted by the Station. The production surveys yielded reliable estimates of the output of all timber products. From studies

WHITE PINE LOG GRADES

Grade	Diameter inside bark (small end)	Length (without trim)	Total deduction permitted[1]	Surface requirements
	Inches	Feet	Percent	
1	13+	8	0	Surface clear 100%
	13-16	12-16	25	Must be 2/3 surface-clear in lengths 8 feet long or longer or 50% surface-clear full length.
	17+	10-16	30	Must be 1/2 surface-clear in lengths 8 feet long or longer or 25% surface-clear full length.
2	9-16	10-16	30	Permits sound, tight knots not over 2½ inches in diameter. Larger, sound, tight knots permitted only if 50% of full-length surface has no sound, tight knots larger than 2 inches in diameter.
	17+	8-16	40	Permits sound, tight knots not over 3 inches in diameter. Larger, sound, tight knots permitted only if 50% of full-length surface has no sound, tight knots larger than 2½ inches in diameter.
3	6-7	8-16	25	Permits sound knots not over 1 inch in diameter or live knots not over 2 inches in diameter.
	8-13	8-16	30	No surface requirements except logs with knots 4 inches or more in diameter in whorls less than 2 feet apart will not be accepted unless 25% or more of full length surface has no sound knots over 2 inches in diameter.
	14+	8-16	40	No surface requirements except that knots over 6 inches in diameter cannot be closer than 3 feet.

[1] Includes sweep, rot, and other cull.

Figure 7.--The white pine log grades used as standards in the forest survey of Massachusetts.

conducted in all types of logging operations, factors were developed, which, when applied to timber-products output, gave timber cut or drain from growing stock.

ACCURACY OF THE ESTIMATES

The estimates in this report may contain two kinds of error. The first type results from possible human errors

such as mistakes in judgment, mistakes in measuring or recording, and errors of reporting. There is no practical way to determine the frequency or magnitude of these errors, but close training and supervision minimize them.

The second type of error is associated with sampling procedures, and it can be measured. If there are no errors of the first kind, the probabilities are two out of three that the actual areas and volumes do not vary from the estimates by more than the following percentages:

	Percent (Plus or minus)
Commercial forest-land area	1.7
Net volume of live sawtimber	6.4
Net volume of growing stock	3.7
Net annual growth of growing stock	14.6

In each of the tables, the total figures are more reliable than the subtotals. The subtotals are more reliable than any of the individual figures. Figures that are small in relation to totals are subject to larger sampling errors.

SPECIES TALLIED

The various tree species tallied in Massachusetts are listed below.[16] Approved common names are shown in parentheses if these differ from the brief names used in the tables. Other tree species may occur within the state, but unless they were tallied on the field plots they were not included in the following list.

COMMERCIAL SOFTWOOD SPECIES

White pine (Eastern white pine) - Pinus strobus
(Red pine) - Pinus resinosa
Pitch pine - Pinus rigida
Hemlock (Eastern hemlock) - Tsuga canadensis
Other softwoods
(Red spruce) - Picea rubens
(Black spruce) - Picea mariana
(Eastern redcedar) - Juniperus virginiana

[16] Little, Elbert L., Jr. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dept. Agr. Agr. Handb. 41. 472 pp. 1953.

(Balsam fir)	- Abies balsamea
(Tamarack)	- Larix laricina
(Atlantic white-cedar)	- Chamaecyparis thyoides

COMMERCIAL SOFT-HARDWOOD SPECIES

Soft maples (Red maple)	- Acer rubrum
(Silver maple)	- Acer saccharinum
Paper birch	- Betula papyrifera
Other soft hardwoods	
(Quaking aspen)	- Populus tremuloides
(Bigtooth aspen)	- Populus grandidentata
(Elm)	- Ulmus species
(Black cherry)	- Prunus serotina
(Yellow-poplar)	- Liriodendron tulipifera
(Black gum)	- Nyssa sylvatica
(Butternut)	- Juglans cinerea

COMMERCIAL HARD-HARDWOOD SPECIES

White oak (White oak)	- Quercus alba
(Chestnut oak)	- Quercus prinus
(Swamp white oak)	- Quercus bicolor
Northern red oak	- Quercus rubra
Other red oaks	
(Black oak)	- Quercus velutina
(Scarlet oak)	- Quercus coccinea
(Pin oak)	- Quercus palustris
Yellow birch	- Betula alleghaniensis
Sugar maple	- Acer saccharum
Beech (American beech)	- Fagus grandifolia
Ash	- Fraxinus species
Sweet birch	- Betula lenta
Other hard hardwoods	
(Hickory)	- Carya species
(Black locust)	- Robinia pseudoacacia

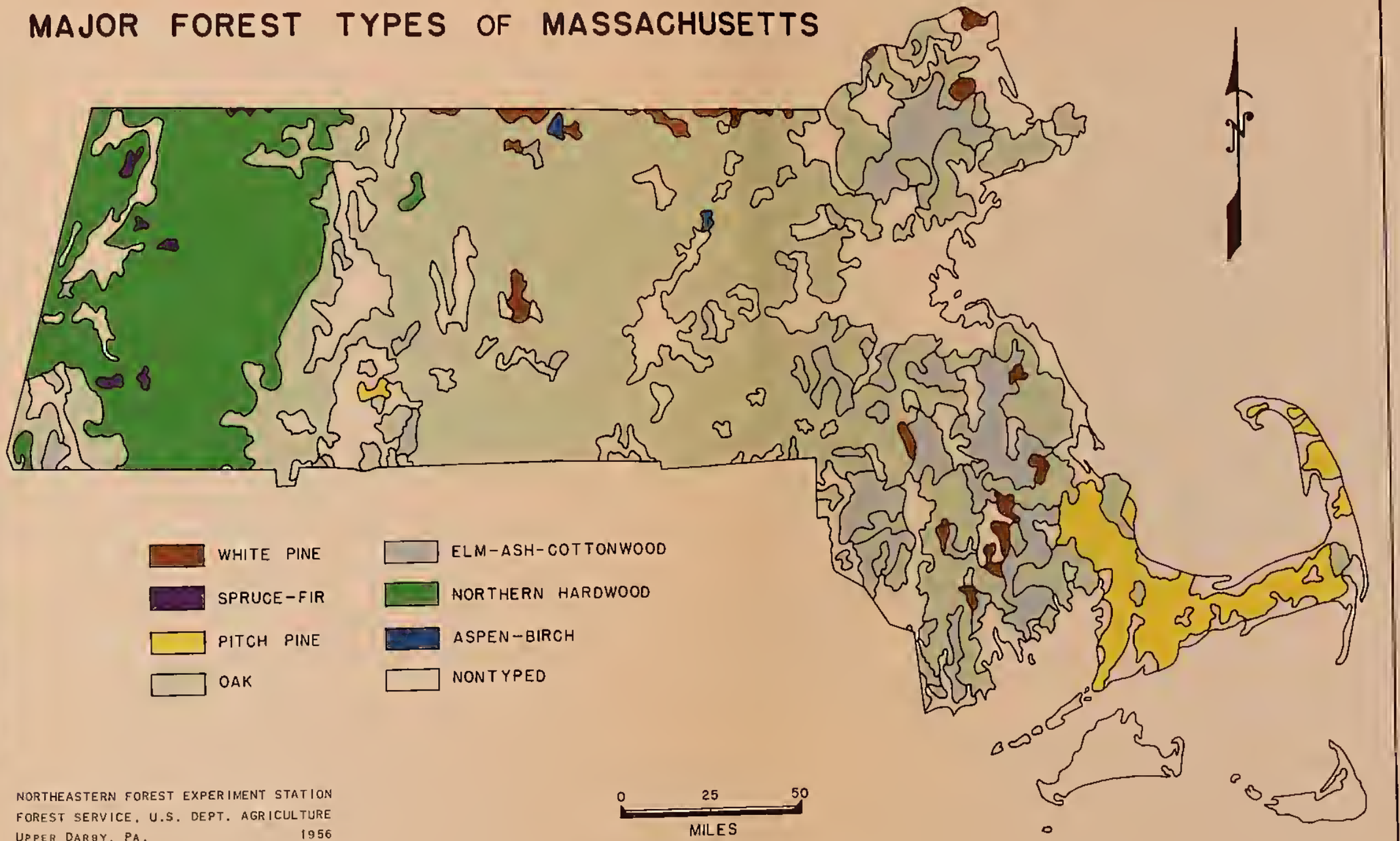
NONCOMMERCIAL SPECIES

Gray birch	- Betula populifolia
Eastern hophornbeam	- Ostrya virginiana
American hornbeam	- Carpinus caroliniana
Sassafras	- Sassafras albidum
Shadbush (Downy serviceberry)	- Amelanchier arborea

NATIONAL STANDARD TABLES

The forest resource reports issued by the U. S. Forest Service contain a set of national standard tables so that data for different areas can be compared; they also are used in making national compilations. In this report the national standard tables are scattered, rather than grouped together. The national standard data can be found in the following tables:

MAJOR FOREST TYPES OF MASSACHUSETTS



NORTHEASTERN FOREST EXPERIMENT STATION
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